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# RIVERS AND THE EVOLUTION OF GEOGRAPHIC FORMS.

BY

ALBERT P. BRIGHAM.

The study of Physical Geography in the light of geology is opening our eyes to see a vast group of land forms to which we had before been blind. Given a land surface, gravitation and the sun's heat, and a complex topography must, in time, result. But we are learning to pass from these general causes down to the more special and obscure modes of world-making, and thus to know and reduce to system the resulting structures. It is not too much to say, that they are as interesting, as various, and as capable of classification, as the groups of the animal kingdom. Thus, glaciation has given us, directly or indirectly, many sharply defined types of geographic form. Or, if we take a group of products such as the lakes of a given area, we might have to resort to half a dozen categories to explain the origin of their basins. This variety is well seen in the forms made by the destructive and constructive work of land streams.

In order that we may get before us the relation of river action to geographic forms, I shall ask you to glance at the extent of some of our river systems, and the ceaseless activity of their waters. It will be under-

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stood that a river system includes all streams which rise within a given hydrographic basin, and whose waters finally pass by one channel into the ocean reservoir.\* The rill and the brook are essential parts of such a system.

A river represents one stage of the water circulation, which is an indispensable part of the organic and inorganic machinery of the globe. The demonstration of the corrosive power of rivers need not concern us here. It has, indeed, been overstated or, at least, thrown out of relation with equally important modes of river action. But let us hold in mind the prodigious activity of such a river system as the Mississippi, with 35,000 miles of navigable waters, and some hundreds of thousands of miles of water current, all told, continuously engaged in making over the physical geography of the central part of the continent.

The combined area of the St. Lawrence and Mississippi basins makes up more than one-fourth of North America; the united territories of the Amazon and La Plata cover more than one-half of South America. The Amazon system has 50,000 miles of navigable waters. Rivers rise in the interior of continents, and pass, by roughly radial lines, toward the periphery. This is much like affirming that water runs down hill, but it is a fundamental law for our present study. The existence of interior closed basins of considerable extent does not seriously affect our rule. In North America, Minnesota is the region of dispersal for the

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\* Affluents diverted from the main stream by delta accumulations and finding the sea by new courses, would, it need hardly be said, still be reckoned as a part of the general system.

great streams which reach the Atlantic, the Gulf of Mexico and Hudson Bay. Western central Europe has four streams which rise high up in the mountain gorges of Switzerland and issue in the Black, the North, the Adriatic and the Mediterranean Seas. A small circle on the map covers the sources of the Rhine, the Rhone, the Danube and the Po. The Nile, the Congo and the Zambezi have their beginnings in the high lake region of eastern central Africa. Asia follows the same law, but with great variation in its plan of drainage, while South America is the nearest approach to an exception. The altitude of the Minnesota region is moderate, that of the African lakes about 3,000 feet, while the headwaters of the central European, and some of the Asiatic rivers, dash down the flanks of the highest mountains.

These commonplaces of physical geography lead us to the statement of the most important and interesting principle which has to do with the making of land forms—the law of base level. This affords us a conception which has been most fruitful both for geology and for geography, and which has been developed chiefly by our later American geologists. It is the doctrine that, given time enough, the erosive and transporting forces will degrade a continental mass so nearly to the sea level that the streams will lose their power to carry away the waste of the land. Probably no more than an approximation to such a goal has ever been reached, but such approaches are seen in many old plateaus, once near the sea level, but now elevated and subjected to a new cycle of erosion. We must picture to ourselves the cutting down, and cutting back toward its source, of

every trunk stream. It is the same with every main tributary. New and subordinate affluents continue to come into being, and a system of valleys will result, which is comparable both in form and mode of extension to a tree and its branches. Gradually the headwaters of adjacent streams will cut back through the ridge which divides their basins, and the higher altitudes will slowly yield, the waste being borne to lower levels and finally to the sea. The work will proceed slowly at first, while the river is forming its habit, rapidly during the middle period, and slowly toward the end, of the cycle of degradation. I quote from Professor William Morris Davis a fine description of this final stage of river life :\*

“Maturity past, and the power of the river is on the decay. The relief of the land diminishes, for the streams no longer deepen their valleys although the hill tops are degraded ; and with the general loss of elevation, there is a failure of rainfall to a certain extent. The slopes of the headwaters decrease and the valley sides widen so far that the land waste descends from them slower than before. Later, what with failure of rainfall and decrease of slope, there is perhaps a return to the early imperfection of drainage, and the number of side streams diminishes as branches fall from a dying tree. The flood-plains of maturity are carried down to the sea, and at last the river settles down to an old age of well-earned rest with gentle flow and light load, little work remaining to be done. The great task that the river entered upon is completed.”

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\* The Rivers and Valleys of Pennsylvania, National Geographic Magazine, Vol. I., No. 3, p. 24.

Suppose now, that a river system has just become well established in a given area. We have, therefore, a country of strong relief and diversified scenery. We will follow our imaginary river from its source to its mouth, observing the work which it does and the forms which it creates. These forms may be carved out of solid material, or built up out of loose material. The river, in vertical section, if we eliminate its lateral wanderings and curves, may be roughly represented by a series of straight lines, much inclined at first, but rapidly changing in attitude, until we have a nearly straight and horizontal line near the sea. The upper part of the river is its torrential stage. In its typical form, it will be a rushing stream, cutting a V-shaped gorge, leaping in cascades, clearing out of its course all débris except boulders, and even these surely break up and are borne away. The steep slopes of a hill or mountain region are dissected by a dendritic system of such narrow, steep valleys, leaving an assemblage of peaks and ridges, broad and rounded, or pointed and narrow, according to the age of the streams and the nature of the under structure. Each brook tries to reach back into the mountains just as every twig of a tree tries to grow longer. Rock material loses much of its weight, relatively, in the water, and so the swift currents hurry it toward the sea, grinding it rounder and finer at every stage of the long journey. The river in its torrential stage is a vast saw. It rasps in its bed with unexampled industry. But no corrosion is accomplished by mere water. It is water, under the pull of gravity, using certain effective tools, which saws deep channels into the crust of the earth, and gives us, next

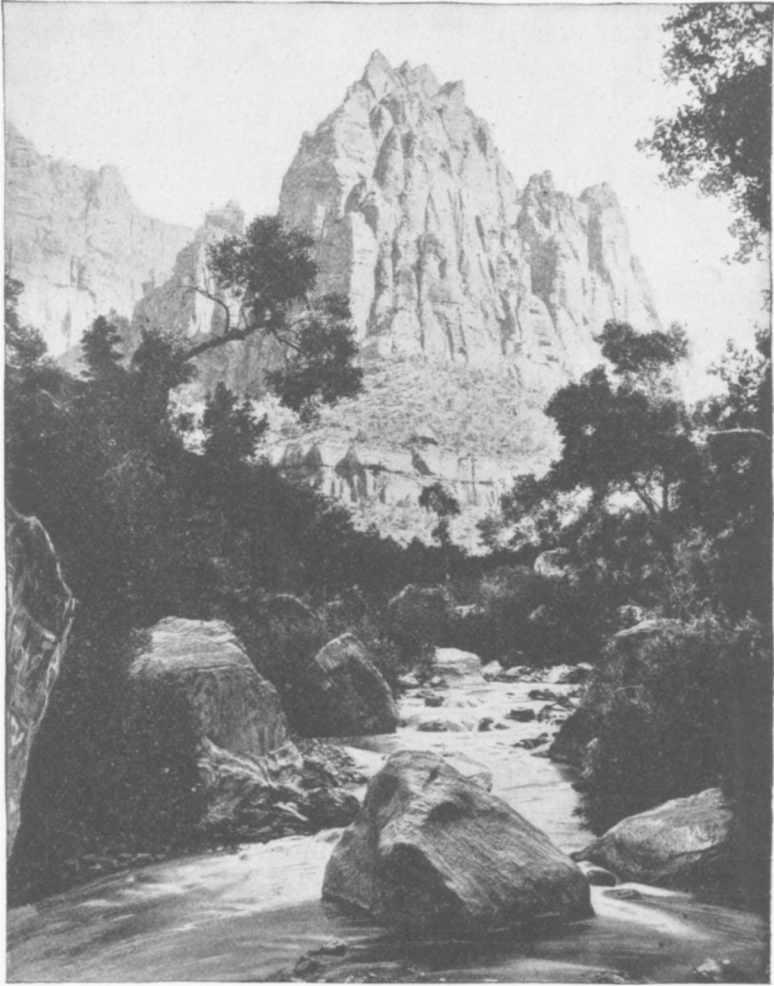
to the mountains, the most impressive of all geographic forms. These tools are boulders and sand. Now if a river be overloaded with such tools, it becomes as powerless to dig as if it had none. Given a stream with rapid fall, and a moderate load of débris, and it is equipped to file down the most obdurate strata.\*

We must also recognize another sharp limit to river action. If I have seemed to ascribe the whole of baselevelling work to rivers, let me hasten to disclaim such intention. River work is important enough in geography, without borrowing undeserved honors. A single topographic result is always the product of a network of causes. Rivers do not baselevel a country. Their chief work is not corrosion. Their glory is in their power as patient burden-bearers—the common carriers of continents. A river digs a channel as wide as its water-flow, and no wider. It can carry and never tire; but it must have help in assuming its load. Rocks fall off into streams, but the initial splitting was done by the frost, or by the growth of a twig. All our soils are creeping down the hill sides. Tillage by human hand helps surprisingly to degrade all our agricultural uplands. Every hill side has its land-slip, small or great. Humble vegetable organisms bring decay to rock surfaces. Atmospheric erosion is universal, and underground water is always preparing the rocks for their ultimate journey toward the sea. The winds are no small factor in this work, and the burrowing animals should not be left out of account. Every hill, if we learn to think truly of it, is becoming lower and smaller,

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\* See Chapter on Land Sculpture, Geology of the Henry Mountains, by G. K. Gilbert.

and every valley, whose bottom is near baselevel, is growing wider. The Catskills are but a vast block of



EAGLE CRAG, RIO VIRGEN, UTAH.

River work and general erosion. The stream, though flowing at a torrential rate, cannot wholly remove the débris.

strata left in their present form by the forces which have etched away the masses about them. The rivers have done relatively little excavating, but a great deal of carrying. The driftless area of Wisconsin offers some of the finest illustrations of this etching process, which, in general, we call weathering, and which is so intimately related to the work of rivers.

I pass to the unloading and constructive work of rivers. If a river slackens its flow, it drops a part of its load. This is a great law. If a torrent descends suddenly into a plain, a vast apron-shaped mass of stony rubbish, sand, mud and drift-wood, will be deposited. Any ravine coming out of a hillside, upon a valley road or field, will give a more or less perfect illustration. It is the structure known as the alluvial cone. If the descent upon the plain is more gradual, the deposition will be more gradual also. Instead of a bouldery channel, we shall begin to find rude terraces of coarse material, and, farther down, we reach the bottom lands, of finer materials, made rich and productive by successive inundations. The river now flows more gently, but is still busily at work. It may cut yet deeper, and gradually form a new flood plain, leaving the remnants of the former one as a pair of terraces on the sides of the valley. Not all terraces are thus formed, but, however made, they are one of the most interesting types of topography. Their lines are approximately straight and parallel, but to the student of earth forms, in spite of their precision, they vie in beauty and interest with the most flowing and graceful contours. I have recently counted a beautiful series of eight distinct benches, rising from the Saxton's River, a

small affluent of the Connecticut, at Bellows Falls, Vermont.\*

We pass now into a tract in which the river begins to struggle with its own sediments, and creates the type known as the meander. This feature of rivers is in a general way familiar to all, but is not understood in its full topographic significance for such regions as that of the lower Mississippi. The elaborate set of maps prepared by the Mississippi River Commission affords data for a most interesting and prolonged study of such forms. The number and extent of the lagoon, or cut-off lakes, are very great. All conceivable gradations of marsh and alluvial bottoms, with resultant forms of vegetation, appear on these maps. New lakes formed by recent cut-offs are mingled profusely with those which are a little older and partially silted up at their ends, and with yet others which are entirely, or, it may be, remotely, shut off from the channel. Besides typical lagoons, or ox bows, all sorts of linear, forked and crescentic lakes are found, lakes which may be said to be entrapped by the rapid extension of sediments. When we remember that a single cut-off may shorten the steamer's track by a dozen miles, and that every such change tends to propagate itself down the stream for long distances, we shall see the geographic significance of this mode of river action. One might almost ascribe intelligence to a river, so fertile is it in resources. At least the notion is a useful one,—it helps us to a dynam-

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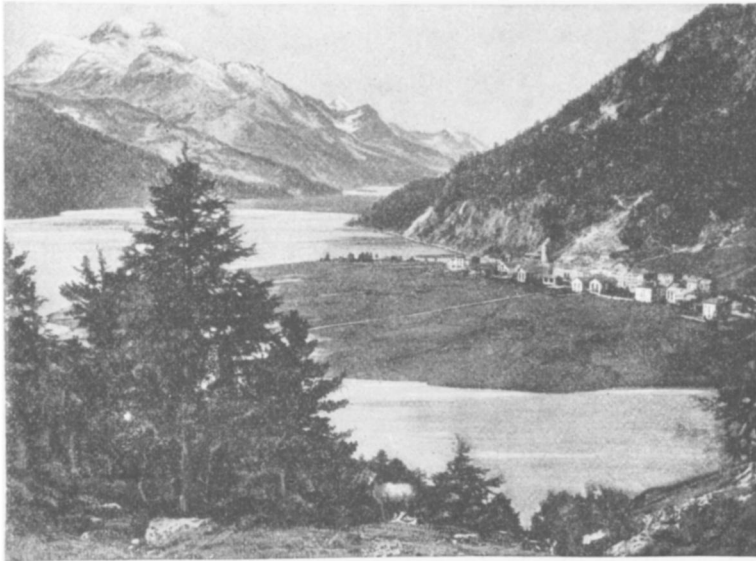
\* The writer's indignation was recently stirred by seeing above a fine terrace near Springfield, Mass., a glaring advertising sign. Worse, if possible, is the sign of a Hartford clothing house on one of the loveliest islands in the Connecticut River. Such treatment of nature is worse than vulgar, it is profane, and demands more of protest than it has yet received.

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ic conception of the earth. The geographer and the geologist will never rightly know the world of form, until they begin to feel it as a world of process. We need to track the planet-making forces at their toil, to see with what sure laws and tireless industry they carve out continents into infinitely varied relief, maintaining land and sea as a fit home for living creatures. A grasp of formal facts is scarcely more important than to get a sense of the life which pervades the physical universe, to feel, as a second nature, that the world is never done, but always making. Geographic forms can no more be appreciated apart from geographic evolution, than the morphology of a horse can be well known, apart from its phylogenic and its embryonic history. I do not know anything more suited than the study of a river, to add what I may call the vital factor to our appreciation of form.

We are now in the region of great river inundations. To discuss the complex conditions which determine floods is apart from the present purpose, but they have one important effect on topography, apart from the familiar one of levelling off the ordinary flood plain. As the flood waters pass from the channel, they slacken flow, and drop part of their burden near the stream. The result is that the alluvium is highest next the stream and slopes toward the walls of the valley. The river bed is also lifted by the deposit of sediment, and we have the phenomenon of a river flowing along the summit of a low ridge. To build a levee is only to accentuate the construction of nature. The magnitude of the levee problem on great rivers lies in these broad depressions beyond and below the river banks. The

Mississippi bottoms average forty miles in width from Cairo to the Gulf of Mexico. The slope southward is but eight inches per mile, while the lateral slope toward the foot hills is six inches in 5,000 feet ; but this lateral slope is seven feet in the first mile from the river bank, on either side.



SILVAPLANA, ENGADINE, SWITZERLAND.

The river here is swelled to a lake by a barrier. A mountain torrent from the right has nearly bisected the lake by depositing the alluvial cone, on which the village stands.

We are now close to the final, or delta stage of the river. Here the whole hour might be spent with profit. Fortunately we are not restricted to borings or diving, to learn the details of delta structure. A great number of what we may call fossil deltas, or sand plains, lie up high and dry, in our northern regions. They were

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formed in the temporary waters of the old ice time, and have since been carefully dissected for our observation. But to return to the deltas of to-day. They mark pre-eminently the deposition stage of the river, and the extension of continental areas. All new land is built out of the waste of old land. This is another great fact in world-making. From what unknown lands even our Archæan rocks have descended, we do not know. Pebbles in the Carboniferous may betray the parentage of the beds as Cambrian, and soon, indefinitely. Material for an area of growing shore line is brought in two ways; by the rivers which pour through it, and by the ocean currents which sweep toward it. But even in the latter case, it is only sediment from some other river. Thus the relatively new land from Cairo south, is the gift of northern areas. An assemblage of erosive forces got the material ready, the river carried it, and the waters of the gulf unharnessed the burden. The land extension within historic time, at the mouth of the Nile, the Po or the Ganges, would afford an interesting field for detailed study. The ancient port of Adria is fourteen miles inland. Rusted rings yet appear in old piers, miles from the sea, at Ravenna. The Po, with the help of glaciers, has brought this world-stuff from the flanks of the Alps and the Apennines, and dumped it into the sea. It will be remembered that tidal rivers, like the Thames or the Amazon, have no deltas. These rivers do their work as faithfully as their delta-making neighbors, their load being carried to other shores, or strewn more widely on ocean floors.

Let us look back for a moment, upon the varying phases of river work. Transportation begins at the

headwaters, and continues, always important, to the ocean. Corrosion is active in the torrential stage, and passes practically down to zero in the lower course of the stream. Deposition begins at the end of the torrential section, and prevails strongly to the ocean. In the middle, or terrace section, the forces approximate an equilibrium. The river lays up its waste in its banks, only to load it up again after months or years, and carry it a stage further toward its destination. Somewhere in descending our stream, we pass the critical point between land destruction and land building. Above this point, materials are gathered up; below, they are strewn down. Above, we have, if we may use the expression, destructive geographic forms; below, constructive forms. Above, it is land sculpture; below it is land modelling. Professor N. S. Shaler has called attention to the fact that one rate of underground flow will enlarge a cavern, while a slightly less rate will occasion the deposit of lime, and seal up the chamber,—one result, or its contrary, by passing a critical point in the rate of a continuous agent.\* So in the case of the river. We pass a critical point in the flow, at which degradation becomes secondary and the work of building becomes dominant. Vertical extension of the continental mass passes into horizontal extension. This brings us back to our great law, the law of baselevel. Busy workers encompass the continental heap and rake it down into the sea. We have a home on *terra firma*, because they cannot quite keep pace with the cosmic forces which ever oppose them, and so they must keep

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\* Aspects of the Earth, by N. S. Shaler, pp. 111-112.

on, sculpturing out the hills which they are ever trying to destroy.

But rivers do not pass, without interruption, such a cycle of history. Many episodes of greatest interest come in, to modify their action, and to determine a wide range of geographic forms. Here again, we emphasize the complexity of geologic forms, and of the resultant topography. Suppose we have a river whose headwaters are frozen. We call such a head stream a glacier, but it is only the river doing its work under peculiar conditions, which, though diverse, are, after all, strangely parallel to the laws of normal river action. And far up the valley, above the frontal ice, the subglacial stream is doing its task in a very river-like way. Other rivers pass into the realm of ice as they enter the sea, and thus the Mackenzie and the great Siberian rivers are subject to clogging and great floods, each varying condition leaving its geographic record.

I can little more than enumerate here the types of fortune to which a river is subject. Geologic understructure is a constant determining factor. Where a river shall go, what kind of a channel it will cut, how much work it will do,—are matters determined, in an infinite number of ways, by the underlying strata. A river flowing on horizontally bedded rocks will tend to have, in its youth, a narrow cañon. The Genesee cañon is as good an example as any; the river is not young, but sections of it have been made young in recent time, and so we see what a juvenile river will do in such geological conditions. Alternations of hard and soft strata give, in early stages of river life, alternations of rock benches and talus slopes; and many terrace-like

horizons on the sides of the valley, mantled commonly by soil, have this origin. Thus a terrace may be built up, or carved out, and it may consist of alluvium, glacial rubbish, or bed rock. Tilted rocks give different types of river valleys in infinite variety. These types may be said to be just now beginning to attract a fair share of the interest of geographers and geologists. They will, in years to come, afford some of the most intricate, as well as most fascinating, problems which are open to inquiry. The memoir on the Rivers and Valleys of Pennsylvania, already noted, may well be consulted by any who are not already familiar with the possible results of such investigation.\* I may briefly refer here to an illustration of a simple case of migration. It is the capture, by Deer Run, of the head-waters of Perkiomen Creek, both being small streams in eastern Pennsylvania.† The character of the case makes it possible for even non-scientific observers to look for similar ones, and with probability of being successful in the search.

The literature of river-changes by the last glaciation is too abundant and too familiar to make it needful or proper that I should take time in this essay to enter this wide field; every ice-ridden region is full of such changes. Most northern streams which survived the ice flow far above their ancient beds, upon glacial rubbish, as Dr. J. S. Newberry and others have shown. I have myself specially noted the vast filling of the north and south valleys, which cross the Mohawk-Susquehanna

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\* Cf. also, *The Geographic Development of Northern New Jersey*, by William Morris Davis and J. Walter Wood, Jr., *Proc. Boston Soc. Nat. Hist.*, Vol. XXIV., 1889.

† Described by Professor Davis, *Science*, Vol. XIII., p. 108.

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divide in our own state. It is sometimes one hundred feet deep, and probably the depth is often much greater. What ancient streams cut these great troughs, in which flow to-day little streams which carry the drainage of a few farms, or of a township? And how much did glaciers enlarge these valleys, and what story do the valleys hold about the ancient geography of the Ontario-Mohawk region? Our geologists have told us much, but they have as yet told us but a fragment of the genesis of the geography of the Empire State, with its important relations to the history of the St. Lawrence and the Great Lakes.

Returning to glacial changes, I note as of special interest here the new Niagara, the new portions of the Genesee at Portage and Rochester, the West Canada Creek at Trenton, and the Mohawk at Cohoes. The pre-glacial river, also, in trying to find a new course, has often run upon obdurate spurs of rock, for a time blocking its course. This, and the same often happens in the original excavation of the valley, occasions what have been called subordinate baselevels. The obstruction holds back the water, giving a tract of non-erosion and deposition above, with rapids below. Many such alternations and sharp variations of descent may occur in the course of a stream.

To us, who see chiefly our eastern types of river and valley, the Colorado River of the West presents a group of conditions which is supremely instructive. Here, the important new factor is the aridity of most of the area traversed by the stream, with the abundant supply of head-waters from regions of precipitation at the North. Added to this feature, we have horizontally bedded

rocks, of varying texture, and a high measure of elevation. The result of such conditions is,—high, rocky plateaus, meagre vegetation, and the profound cañons of that region. The descent of the Ohio-Mississippi from Pittsburg to Vicksburg is 699 feet. The descent of the Colorado from the Green River Station of the Union Pacific Railway to its mouth, about the same distance, is 6,000 feet. Observe the conditions for erosion, or general weathering. They are highly unfavorable, the country is too dry. To be sure, there is no mantle of vegetation and soil comparable to that which protects our eastern rocks, but this is not the dominant factor. On the other hand, notice that the corrosive power of the river is at its best with abundant water supply and large fall. Notwithstanding, a stupendous general erosion has been accomplished, stripping off thousands of feet of strata, not more, indeed, than in the Appalachians, but more striking, because visible to every eye in the gloriously colored cliffs of each section of the plateau, remaining to show just how far the work has gone. Nor can the corrosive power of the river have credit, even, for the cañon. It is responsible for its depth, but not for its immense breadth. The river saws its narrow groove, and the dropping of huge blocks and the etching out of those titanic architectural forms that line the walls have made the greater part of the chasm. Here is added emphasis to the principle already insisted on, that the great function of rivers is transportation. We leave the Colorado honor enough, and more than Mr. Prestwich will grant, for he still thinks the cañon must be due to a fissure, although he concedes the lack of evidence. Let me add, that

Dutton seeks to dispel the common erroneous notion that the cañon is narrow and dark. Its upper walls range from seven to twelve miles apart. The study of the Plateau region, by Powell, Dutton, Gilbert and their assistants, has given us a body of doctrine which aids us at every turn in physiographic research.†

The last interruption of the normal river cycle, which I wish to note, is by oscillation. Here the Hudson is our illustration. Elevate a baselevelled country and the streams renew their life. New rapids and falls are formed, and a diverse topography is again developed. Thus when the Hudson found the Atlantic eighty miles to the southeast of New York harbor, it was cutting out the rock channel between New York and Jersey City, a channel now far beneath the deposit of loose stuff laid down since the country was submerged in part, and the waters of the Atlantic drowned the Hudson. Lift the country again, and you can dispense with dredging, and the great river boats will ply their trade no more. The streams of New England are now engaged in dissecting the old baselevel, which has been hoisted up from the sea. But the Hudson valley has also been more depressed than it is to-day, in that glacial or post-glacial time when the valleys of this great estuary were filled with the clays, which now rise one hundred feet and more above the stream. It might be a difficult matter to determine whether the streams, or the brick-makers, are working the more effectively to cut away these clays.

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† See *Geology of Uinta Mountains, and Exploration of the Colorado River of the West*, by J. W. Powell; *Geology of the Henry Mountains*, by G. K. Gilbert; *Geology of the High Plateaus of Utah and Tertiary History of the Grand Cañon District*, by C. E. Dutton. The last work, pp. 230-260, gives an especially useful discussion of the conditions of erosion found in the Plateau region.

The lifting of a limited area of the earth's crust, as in mountain folding, affords a different problem, or a different aspect of the same problem, if we think of continental and mountain elevation as going on together. Here the question is, whether the river can saw down as fast as earth stresses can lift up. If the river is the winner, we call it, after Powell, an antecedent river. If the folding outdoes the river, a new channel gathers the drainage and we have a consequent river. The antecedent river finds its type in that vigorous stream which has crossed and slit in two a portion of the Uinta Mountains.

I have been able only to touch, here and there, one of the greatest of geographic themes. The river is profoundly and beautifully related to the morphology of continents. Its distinctive work is transportation; and, with its attendant forces, it destroys the old land and builds the new, rejuvenating the planet, making the most beautiful scenery, depositing the richest soil, and carrying to an uncounted company of marine organisms their daily food.

The Oriental is perhaps the most unscientific of human kind. Do not understand me to attribute a scientific formula to him; I only give him credit for seeing what the desert streams did, every day, as he looked upon them. They have done the same for centuries since his day, as they had done the same for æons before his time. I quote from an old Hebrew poem:

And surely the mountain falling cometh to naught,  
And the rock is removed out of its place,  
The waters wear the stones,  
The overflowings thereof wash away the dust of the earth.

We can hardly improve upon the observation, though

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we should be apt to drop the poetic dress, and say that the country was working down toward a baselevel. If we turn to social and economic geography, we cannot overstate the significance of rivers, whether we watch the angry, dashing torrent which comes down the mountain, lifting its roar, and flashing its spray in the face of the sun, or whether we go down through broad valleys and stand on the banks of

The great rivers which move like God's eternity.

Never twice the same, the river, by day and by night, fills its place in the economy of the world. The landscape, with its delight for the eye, its thought of peace, or emotion of sublimity, has everywhere felt the moulding power of the river.

Rivers are the determining forces of civilization. Discovery, agriculture, arts and commerce march up the track of rivers as unerringly as the waters meet them in passing to the sea. The American continent swung open its gates at the Mississippi and the James, the Hudson and the St. Lawrence. The best land in the world is the alluvium of rivers,—the Mohawk flats, the Mississippi valley, the Connecticut bottoms, the Netherlands and the Nile, suggesting Emerson's farmers, who

Thank the spring flood for its fertile slime.

The Hudson, the Mississippi, the Thames and the Amazon are the greatest of all highways. Lines of railway seek the grades already surveyed and levelled by streams. All water power is in the cosmic force of gravity, as it pulls the rainwater from the land heights to the sea. Most inland cities are determined by rivers. Albany and its attendant cluster of cities are the gift

of the Hudson. Dr. Newberry reminds us that all the salt wells of Syracuse are sunk in the gravel of a buried channel. Thus an old pre-glacial river laid the foundation of Syracuse. Rochester grew up over a river, and on the brink of a cataract. St. Paul, Minneapolis, Philadelphia, Baltimore, Washington, Richmond and New York, each in its way, tell the same story. Not the ocean, but the Hudson River and the Mohawk Valley made New York the metropolis of the New World.

One need not go far to study rivers. Any rill will serve well. The brook and the Mississippi behave alike. The road side will show you cañons, and the little stream is on the way to the sea with its load. It has its meanders, its terraces, its sandbars and deltas. Know the brook, and you will know the river. He who knows the river will have a new appreciation of the use, the beauty and the glory of nature.